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ANALYSIS OF PARTICULATES OF COMET NUCLEUS SAMPLES; POSSIBLE USE OF OLIVINE AS INDICATOR PHASE. I. M. Steele, Dept. of Geophysical Sciences, University of Chicago, 5734 S. Ellis Ave., Chicago, IL 60637.

The electron microprobe is a proven instrument for particulate analysis and modifications are possible for *in situ* analysis of particulates in ice at temperatures near that of liquid nitrogen. Present sample requirements allow for polished samples with 0.25 x 0.25 dimensions to be maintained in the sample chamber of a modern electron probe (CAMECA SX-50) at a temperature of -150^{o}C; larger samples are possible but at higher temperatures as determined by thermal conductivity. The major problem is transport and insertion of samples into the instrument through vacuum interlocks. The manufacturer of the above microprobe has designed on paper an exchange mechanism to allow storage and transport of samples previously prepared for their sample holder which attaches to their instrument allowing extraction and insertion of samples while maintaining -150^{o}C temperature. An important test will be the capability of preparing polished surfaces of an ice-particulate sample without loss of particles and at low temperatures. While thin sections of water ice are routine, these are not examined for particulate material and are prepared at temperatures easily obtained in room-size volumes. Anticipated problems include rounding of small grains in the relatively soft ice matrix and the technical problem of dry polishing.

Less constraining is the analysis of particles recovered from ice; those larger than about 10 microns can be handled individually or as a group permitting preparation of polished grain mounts. Below this size, analysis techniques for unpolished samples must be used. In general the larger the grain, the greater the current and kV of the primary electron beam permitting detection of minor and trace elements. Typical examples of grain size, analysis conditions and expected results can be obtained from extensive analysis of forsterite grains in meteorites and other extraterrestrial samples including deep sea and stratospheric particles and Greenland lake sediment:

1) Polished large grains (>20 microns): 25 kV, 100nA; Mg, Al, Si, P, Ca, Sc, Ti, V, Cr, Mn, Fe, Ni; detection limits 30-70ppm.
2) Polished small grains (10-20 microns): 15 kV, 25nA; Mg, Al, Si, Ca, Cr, Mn, Fe, Ni; detection limits 100-200ppm.
3) Unpolished grains (<10 microns): 15 kV, 25 nA; Mg, Si, Ca, Cr, Mn, Fe, Ni; detection limits >150ppm with errors greatest for light elements with high absorption.

The above generalized analytical limits can be extended in many cases by parallel use of the x-ray microprobe utilizing synchrotron radiation.

The above data for olivine are based on extensive analyses in all types of olivine-bearing extraterrestrial material (1,2). Because this phase is possibly the most common phase, shows relatively simple crystallography, and is the most widespread high-temperature phase, its use for comparison among the different sample types has proved fruitful. For example, the levels and trends of minor elements allows the recognition based on single grain analyses of olivine in the following meteorite groups: 1) C3-UOC (unequilibrated ordinary chondrites); 2) C2; 3) C3. Manganese, for example, appears to show a systematically higher level in olivines from the C1 meteorites and the Cr-Fe variation is clearly different for C2 and C3-UOC olivines. Although extensive analyses have not been made, the surviving olivines in the deep sea particles are chemically similar to C2 olivines (3); data are too few to derive analogous relations for stratospheric particles and Greenland lake sediment but the samples are available.

Assuming that olivine is a constituent of cometary particulate material (4,5), its chemical relations to the known olivine-meteorite associations would be a powerful constraint for relating the earliest phases within all these materials.

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